MONTHLY PROGRESS REPORT
Slurry/Micro-Surface Mix Design Procedure
October—December 2005

To: **T. Joe Holland, CALTRANS**
Contract No.: **CALTRANS 65A0151**
Contractor: **Fugro Consultants LP**
Contract Period: **June 30, 2003 – Nov. 30, 2007**
Prepared By: **Jim Moulthrop, Principal Investigator**
Date Prepared: **January 11, 2006**

PROJECT OVERVIEW

The overall goal of this research is to improve the performance of slurry seal and micro-surfacing systems through the development of a rational mix design procedure, guidelines, and specifications.

Phase I of the project has two major components: 1) the first consists of a literature review and a survey of industry/agencies using slurry and micro-surfacing systems, 2) the second deals with the development of a detailed work plan for Phases II and III.

In Phase II, the project team will evaluate existing and potential new test methods, evaluate successful constructability indicators, conduct ruggedness tests on recommended equipment and procedures, and prepare a report that summarizes all the activities undertaken under the task.

In Phase III, the project team will develop guidelines and specifications, a training program, and provide expertise and oversight in the construction of pilot projects intended to validate the recommended design procedures and guidelines. All activities of the study will be documented in a Final Report.

NOTE: New information for the current month is notated by double-lines to the left of text, tables, or figures.

PHASE I—LITERATURE SEARCH AND WORK PLAN DEVELOPMENT

Task 1 Literature Review and Industry Survey—Completed

The literature review process is complete with all sources of information on the design and use of micro-surfacing and slurry seals reviewed and summarized in Chapter 2 of the Phase I Report. The three survey questionnaires were included in the August 2003 monthly report and the results were summarized in the Phase I Report.

Task 2 Work Plans for Phases II and III—Completed

All activities of Phase I are complete. The results are included in the Phase I Interim Report that was submitted to CALTRANS in March 2004. The Phase II Work Plan was included in Chapter 3 of the Phase I Report. The Phase III Work Plan was included in Chapter 4 of the Phase I Report.

PHASE II—MIX DESIGN PROCEDURE DEVELOPMENT

A videoconference was held on September 15, 2005 with 10 States, FHWA representatives, and members of the research team participating. The team presented progress on Phase II and Phase III activities and responded to questions from the participants. Major issues/questions were addressed in the September 2005 monthly report.

As mentioned during the videoconference, the team will evaluate different possible field acceptance tests and procedures; however, it is to early to make recommendations in that respect. More information on the candidate field tests and sampling procedures will be included in the next monthly report.

Tasks 3 & 4—Evaluation of Potential Test Methods & Successful Constructability Indicators

Progress on Tasks 3 and 4 were summarized in the August 2005 progress report as well as presented at the September 15, 2005 videoconference. Draft test protocols for the AMT and CAT tests were included in Appendices A and B of the September 2005 report.

Testing continued during the last three months and a spreadsheet with the testing matrix indicating the status of the testing is attached as Appendix A to this report. Tests that have been completed are noted with the code, "C," those that have been completed but have not had a quality control check are noted with the code "IP." The goal as expressed during the September videoconference was to have all the testing completed by 31 December. As can be seen from the spreadsheet, testing remains to be done and should be completed by January 20, 2006.

To complete the testing matrix, we have made arrangements to acquire the third aggregate and emulsion. The aggregate is a sandstone from Delta Materials in Marble Falls, TX, and the emulsion is from Ergon Asphalt and Emulsions, Inc., from their Waco, TX, plant. These materials are scheduled for delivery by January 10, 2006 to the CEL Lab.

Draft Specification

A first draft of the specification has been developed in August 2005. Traffic, temperature, humidity and the desired set time dictate the threshold values to be met by a particular slurry system. The draft specification was provided in Appendix C of the September 2005 report.

Task 5—Ruggedness Tests of Recommended Equipment and Procedures

In comparison with the testing in Tasks 3 and 4, the tests of Task 5 will be performed at a single set of temperature, humidity, and cure time conditions. "Standard" conditions were chosen by the team (e.g., 50 percent humidity, 25°C temperature). Slight variations in these parameters will be allowed to evaluate the ruggedness of the test procedures. The team is currently reviewing the test factorials proposed in the Phase II Work Plan.

Task 6—Phase II Report

No Activity

PHASE III— PILOT PROJECTS AND IMPLEMENTATION

Task 7—Development of Guidelines and Specifications

A list of references that contain guidelines and specifications has been drafted and is noted below:

- ISSA A105 Guidelines for Slurry—Available
- ISSA A143 Guidelines for Micro-Surfacing—Available
- TTI Report 1289-2F Use of Micro-Surfacing in Highway Pavements—Available.
- Report contains:
    - Methods and Materials Specifications
    - Quality Control and Assurance Tests (including field cohesion and vane shear tests)
    - Quality Control Guidelines (including materials acceptance tests and mixture design verification)
    - A Checklist
    - Usage Guidelines.
- ISSA Inspector's Manual—Available
- Caltrans Maintenance Technical Advisory Guide Final Draft—Available
- The ISSA Workshop Folder—Available

The guidelines and specifications will be a concise collection, presented in AASHTO format. This is one area of Phase III where the team can work at present. At the end of Phase II, the document will be appended with findings and recommendations relative to the new tests developed in Phase II.

Task 8—Workshop Training Program/Pre-Construction Module

The team agreed that work could commence in several chapters of the Reference Manual to be developed under this task. The Reference Manual will be a comprehensive, textbook-like document with background information, explanations, and pertinent information on the design and use of slurry systems. A first draft of the Reference Manual has been included in Appendix A of the August 2005 progress report.

Task 9—Pilot Projects/Procedure Validation

The team developed guidelines for selecting pilot projects to be used by State agencies. The proposed pilot project layout contains six different sections:

- A control section placed using the ISSA current procedure.
- A bare section (do nothing)
- Improved mix design (using the method developed in Phase II), Replicate 1
- Another contractor-based control (ISSA design).
- Another bare section.
- Improved mix design (using the method developed in Phase II), Replicate 2

The final version of the Guidance Document was included in Appendix A of the October 2004 and April 2005 progress reports. The document was forwarded to the participant State agencies and other agencies interested in participating in the pilot project study.

An alternative layout was proposed in the September 2005 report, for pavements on which snowplows are used.

The State of Vermont has contacted Fugro and Caltrans with a potential test section. We have asked the contact to provide us with a location map and important details of the section.

Task 10—Final Report

No Activity

NEXT MONTH'S WORK PLAN

The activities planned for next month are listed below.

- Complete the testing matrix
- Obtain aggregates and emulsion to fill out the matrix
- Coordinate with CALTRANS personnel on an as-needed basis.
- Continue with Phase II and Phase III activities.

PROBLEMS / RECOMMENDED SOLUTIONS

All problems with the acquisition of the test equipment have been overcome. Significant progress has been made during the last three months.

APPENDIX A

Testing Matrix

Phase I: Development and Evaluation of New Tests

3 Aggregates:

A1 Table Mountain (ISSA Type III)

A2 Lopke Gravel Products (ISSA Type III)

A3 Unknown

3 Emulsions:

E1 SEM Ralumac

E2 Polymer Modified CQS-1h, VSS Emultech

E3 Unknown

5 Mixes:

M1 A1+E1 Table Mtn + SEM

M2 A1+E2 Table Mtn + VSS

M3 A2+E1 Lopke + SEM

M4 A2+E2 Lopke + VSS

M5 A3+E3, Unknown

C = Completed

IP = In Progress

Aggregate Tests				A1	A2	A3		
Sieve Analysis				C	C			
LA Abrasion				C	C			
Sulfate Soundness				C	C			
Sand Equivalent				C	C			
Durability				C	C			
New: Microdeval				IP	IP			
Emulsion Tests				E1	E2	E3		
Residue Recovery				C	C			
Penetration				C	C			
Ring and Ball Softening Point				C	C			
Dynamic Shear Rheometer				IP	IP			
Mix Tests				M1	M2	M3	M4	M5
Mixing Time (ISSA TB 113)								
Observations Blot test/coating/consistency				C	C	C	C	
AMT								
10C	lab humidity							
25C	lab humidity			C	C	C	C	
35C	lab humidity							
Modified Cohesion Test (ISSA TB 139)								
25C	50% humidity	compacted	1hr cure	C	C	C	C	
25C	50% humidity	compacted	1day cure	C	C	C	C	
25C	50% humidity	compacted	oven cure	C	C	C	C	
25C	50% humidity	not compacted	1hr cure	C	C	C	C	

25C	50% humidity	not compacted	1day cure	C	C	C	C		
25C	50% humidity	not compacted	oven cure	C	C	C	C		
25C	90% humidity	compacted	1hr cure						
25C	90% humidity	compacted	1day cure						
25C	90% humidity	compacted	oven cure	?	?	?	?		
25C	90% humidity	not compacted	1hr cure						
25C	90% humidity	not compacted	1day cure						
25C	90% humidity	not compacted	oven cure	?	?	?	?		
New: Automated Cohesion Test (ACT)									
10C	50% humidity	compacted	1hr cure						
10C	50% humidity	compacted	1day cure						
10C	50% humidity	compacted	oven cure						
10C	50% humidity	not compacted	1hr cure						
10C	50% humidity	not compacted	1day cure						
10C	50% humidity	not compacted	oven cure						
10C	90% humidity	compacted	1hr cure						
10C	90% humidity	compacted	1day cure						
10C	90% humidity	compacted	oven cure						
10C	90% humidity	not compacted	1hr cure						
10C	90% humidity	not compacted	1day cure						
10C	90% humidity	not compacted	oven cure						
25C	50% humidity	compacted	1hr cure						
25C	50% humidity	compacted	1day cure						
25C	50% humidity	compacted	oven cure						
25C	50% humidity	not compacted	1hr cure						
25C	50% humidity	not compacted	1day cure						
25C	50% humidity	not compacted	oven cure						
25C	90% humidity	compacted	1hr cure						
25C	90% humidity	compacted	1day cure						
25C	90% humidity	compacted	oven cure						
25C	90% humidity	not compacted	1hr cure						
25C	90% humidity	not compacted	1day cure						
25C	90% humidity	not compacted	oven cure						
35C	50% humidity	compacted	1hr cure						
35C	50% humidity	compacted	1day cure						
35C	50% humidity	compacted	oven cure						
35C	50% humidity	not compacted	1hr cure						
35C	50% humidity	not compacted	1day cure						
35C	50% humidity	not compacted	oven cure						
35C	90% humidity	compacted	1hr cure						
35C	90% humidity	compacted	1day cure						
35C	90% humidity	compacted	oven cure						

35C	90% humidity	not compacted	1hr cure							
35C	90% humidity	not compacted	1day cure							
35C	90% humidity	not compacted	oven cure							
Wet Track Abrasion Test (ISSA TB 100)										
25C	lab humidity	non compacted	1 hr soak		C	C	C	C		
25C	lab humidity	non compacted	6 day soak		C	C	C	C		
CAT Test										
25C	90% humidity	compacted	30min		IP	IP	IP	IP		
25C	90% humidity	compacted	60min		IP	IP	IP	IP		
25C	90% humidity	compacted	180 min		IP	IP	IP	IP		
25C	90% humidity	compacted	300 min	1 hr soak	IP	IP	IP	IP		
25C	90% humidity	compacted	oven cure	6 day soak	IP	IP	IP	IP		
25C	90% humidity	non compacted	30min		IP	IP	IP	IP		
25C	90% humidity	non compacted	60min		IP	IP	IP	IP		
25C	90% humidity	non compacted	180 min		IP	IP	IP	IP		
25C	90% humidity	non compacted	300 min	1 hr soak	IP	IP	IP	IP		
25C	90% humidity	non compacted	oven cure	6 day soak	IP	IP	IP	IP		
25C	lab humidity	compacted	30min		IP	IP	IP	IP		
25C	lab humidity	compacted	60min		IP	IP	IP	IP		
25C	lab humidity	compacted	180 min		IP	IP	IP	IP		
25C	lab humidity	compacted	300 min	1 hr soak	IP	IP	IP	IP		
25C	lab humidity	compacted	oven cure	6 day soak	IP	IP	IP	IP		
25C	lab humidity	non compacted	30min		C	C	C	C		
25C	lab humidity	non compacted	60min		C	C	C	C		
25C	lab humidity	non compacted	180 min		C	C	C	C		
25C	lab humidity	non compacted	300 min	1 hr soak	C	C	C	C		
25C	lab humidity	non compacted	oven cure	6 day soak	IP	IP	IP	IP		
10C	90% humidity	compacted	30min							
10C	90% humidity	compacted	60min							
10C	90% humidity	compacted	180 min							
10C	90% humidity	compacted	300 min	1 hr soak						
10C	90% humidity	compacted	oven cure	6day soak						
10C	90% humidity	non compacted	30min							
10C	90% humidity	non compacted	60min							
10C	90% humidity	non compacted	180 min							
10C	90% humidity	non compacted	300 min	1 hr soak						
10C	90% humidity	non compacted	oven cure	6day soak						
10C	lab humidity	compacted	30min							
10C	lab humidity	compacted	60min							
10C	lab humidity	compacted	180 min							
10C	lab humidity	compacted	300 min	1 hr soak						

	10C	lab humidity	compacted	oven cure	6day soak					
	10C	lab humidity	non compacted	30min						
	10C	lab humidity	non compacted	60min						
	10C	lab humidity	non compacted	180 min						
	10C	lab humidity	non compacted	300 min	1 hr soak					
	10C	lab humidity	non compacted	oven cure	6day soak					
	35C	90% humidity	compacted	30min						
	35C	90% humidity	compacted	60min						
	35C	90% humidity	compacted	180 min						
	35C	90% humidity	compacted	300 min	1hr soak					
	35C	90% humidity	compacted	oven cure	6 day soak					
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	35C	lab humidity	compacted	30min						
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	35C	lab humidity	non compacted	oven cure	6 day soak					